sterile water. (e) If dura is injured, remove all foreign bodies, fragments of bone and lacerated brain tissue by means of irrigation with hot saline solution and suction by means of a soft rubber catheter. **Do not use finger.** (f) Before closure irrigate brain cavity and all wound surfaces with dichloramine T. (g) Close dura if possible, and scalp with through and through stitches.

7. **Bacteriologic Study of Wounds.** In immobile hospitals near enough to the line to receive wounded men within twelve hours, and equipped to retain them after operation, bacteriologic study of the wounds in conjunction with the use of Carrell-Dakin solution furnished an accurate guide as to the time of closing debrided wounds. A wound free from streptococci and with only one colony of other organisms in every five fields, was considered safe for **closure.**

8. **Shock.** The cases of shock from wounds and hemorrhage were very numerous and constituted a large proportion of the seriously wounded treated in front line hospitals. The shock wards were usually full during the great drives and it was one of the most distressing and unsatisfactory fields of work. It was my good fortune to be associated with Lieutenant-Colonel W. B. Cannon, Professor of Physiology at Harvard, in the management of the shock ward during the great German offensive of July 14th and 15th. Prof. Cannon was in charge of all shock work in the A. E. F. and he made many valuable observations on shock both at the front and in the Central Laboratory at Dijon. An unusual opportunity was offered in this war for first hand observations in a very large number of cases of shock. The outstanding features revealed by these observations were: (a) The important relation of blood pressure to prognosis in shock. The critical level was found to be 80 m.m. of mercury. If the systolic pressure remains for more than an hour below this level, there is an insufficient supply of oxygen to the tissues and a condition of acidosis supervenes. (b) It was found that there was a marked difference between the number of corpuscles found in the samples of blood from the veins and those from the capillaries. This difference often amounted to 2,500,000 per cubic millimeter indicating that the lost blood in shock is stagnated in capillaries. (c) Exposure to cold is an important factor in producing shock. Men in good condition when they left the front would often arrive at the evacuation or field hospital in shock. In the treatment of shock, the essential measures employed were heat, hot drinks, rest, morphine and transfusion. Blood, citrated, was found to be the most reliable and lasting method of raising blood pressure. Gum salt solution suggested by Bayliss was found to be more lasting in its effects than salt solution, due to its greater viscosity. When given in the first three or four hours of shock, its action was remarkable, but its later use was found disastrous and it was the consensus of opinion that it hastened death if given after twelve hours.

In my series of cases there were twenty-six deaths. Of these, ten were due to gas gangrene, six were due to peritonitis complicating abdominal injuries, two the result of compound fractures of both femurs, requiring double amputations, two resulted from injury to the axillary artery. One each was due to perforation of femoral artery from septic infection, penetrating wound of chest, with gas gangrene, perforation of rectum and bladder, gunshot wound of rectum, perineum and back and one from wound of neck and jaw, with sepsis and hemorrhage.

SPINAL ANESTHESIA IN UPPER ABDOMINAL SURGERY.

By L. L. STANLEY, M. D., Resident Physician California State Prison, San Quentin, California.

During the past four years spinal anesthesia has been used almost exclusively in all operations below the nipple line, on inmates of the California State prison at San Quentin. During this time about 600 operations have been performed, of which 68 were for conditions which necessitated incisions somewhere below the nipples and above the umbilicus.

These higher operations were not attempted until after it had been satisfactorily demonstrated that spinal anesthesia induced by tropacocaine was entirely efficient in hernias, appendectomies, and other surgical procedures of the lower abdomen and lower extremities. The operations which have been performed with this method of anesthesia are:

Appendectomies, acute and chronic	69
Fistula in ano	58
Hemorrhoids	99
Hernia	147
Varicose veins	40
Various operations on legs and thighs	36
Urethral strictures	28
Operations on scrotum	59
Gastroenterostomy	47
Splenectomy	2
Exploratory laparotomy, upper	7
Excision gastric ulcer	1
Cholecystotomy	1
Cholecystenterostomy	1
Finney's pyloroplasty	2
Hernia, epigastric, recurrent	5
Volvulus	1
Total	603

By reasoning that the tropacocaine solution having a specific gravity of 1027 in cerebro spinal fluid with a gravity of 1007, would be influenced by the difference in weight, it was believed that by placing the patient in a slightly inclined Trendelenberg position, the fluid would go toward the head and produce anesthesia in the upper segments. This was demonstrated on a number of patients on whom operations below the level of the umbilicus were performed. The sensations were tested and found to be abolished in the epigastrium, to the level of the nipples, and sometimes even in the arms and hands subsequent to the production of anesthesia in the lower segments, when the body was placed at an angle of 10-12 degrees to the horizontal. The fluid had, in descending toward the head, bathed the dorsal nerve roots and produced in them the loss of sensation.

The gravitation of the fluid was also demonstrated in a still warm cadaver, thirty minutes after legal execution by hanging. Twenty-five minims of cerebrospinal fluid were withdrawn from the spinal canal. Into this was dissolved one and one-half grains of tropacocaine, together with a few drops of methylene blue. After this was reinjected into the spinal canal, the body was placed with the pelvis slightly elevated for five or six minutes. On rhachiotomy it was shown that the spinal cord tissues were stained as high up as the fourth dorsal vertebra from which emerges the fourth nerve supplying the region about the nipples.

The first upper abdominal operations performed here in 1914 were not satisfactory. It was found that the blood pressure in a few cases fell quite low, that the patient was frightened, that the anesthesia did not last long enough, and that there was some discomfort when the stomach was handled. Later on these difficulties were remedied.

The blood pressure was taken every five minutes and carefully recorded. If it were found greatly reduced, four or five drops of adrenalin in normal salt were given subcutaneously, with very quick response. Only in rare cases, however, did the fall in blood pressure cause alarm.

It had been the custom to operate on these cases without previously giving an opiate, and whereas many were able to control their temerity, it was considered best to administer one-fourth gr. morphine sulphate and 1/160 atropine, half an hour before commencing to operate. In this way it was found that the patient came to the operating room with his fears allayed, and in many cases, slept during the whole operation.

The sensibilities were so dulled by the opiate that the conversation of the attendants or the click of the instruments did not produce fear or excitement. After the anesthetic was administered, the patient was placed on his back, and a moist towel placed over his eyes to exclude light.

With an injection of 1½ gr. of tropacocaine, it was found that the anesthesia lasted less length of time than with three grains. With the former dosage the time was about 1′ 45″. The larger dose did not produce any ill effects and was well stood by the patient. In the earlier cases when 1½ grs. was used, the anesthetic wore off before the operation could be completed, and it became necessary in some of these cases to finish with ether. This procedure, even so, is not at all bad, for the small amount of ether necessary to complete the operation tends to bring the blood pressure back to normal. Administering the ether is not difficult, for with the spinal anesthetic, the patient cannot move, and the surgeon may continue with his work unmolested while the inhalant is being given. It is not often necessary to finish with the ether, for most of the upper abdominal operations can be completed before the effect of the tropacocaine subsides.

After injecting the anesthetic solution into the spinal canal, four or five minutes elapses before the epigastrium is desensitized. In order to spare these few minutes the site of the operation is quickly prepared with sterile towels, and a few c.c. of one-half per cent. novocaine solution are injected under the skin in the line of incision. By this method, the abdomen can be opened, and by the time the viscera are reached, the whole region is well anesthetized. This procedure is not necessary except as a saving of a little time.

The following is one of the records, showing chronologically, the procedure during the anesthesia. Similar charts are kept on all operations:

Name, P ——; number, 29594; sex, male; age, 24; weight, 141; occupation, waiter; diagnosis, gastric ulcer, gastroenterostomy and appendectomy.

3/23/17.

12:05	P. M.	Blood pressure 124 syst. 70 diast.
12:06	"	Pulse rate 78.
12:50	"	1/8 M. S. and 1/320 atropine.
1:20	"	1/8 M. S. and 1/320 atropine.
1:45	"	Anesthetic administered, tropacocaine grs. 3 between last dorsal and first lumbar.
1:45	"	Head lowered.
1:49	"	Operation begun. Could not move legs.
1:50	"	Head raised.
1:51	"	Pulse rate, 120.
1:55	"	" " 96.
2:09	"	" " 90; bld. prs. 70 syst 50 diast
2:19	"	" " 90; " 70 " 50 "
2:29	"	" " 90; " 70 " 50 "
2:39	"	" " 90; " 72 " 50 "
2:49	"	" " 90; " 72 " 50 "
2:59	"	" " 90; " 72 " 50 "
3:03	"	" " 90; " 72 " 50 "
3:45	"	Felt pain and could move legs.
7:00	"	Blood pressure 100 syst. 70 diast.

3/25/17.

7:00	P. M.	Blood pressure 124 syst. 70 diast.

Remarks:—Pupils slightly dilated; complexion slightly paler than normal; puncture made patient recumbent left side; anesthesia complete to line above nipple line; ½ dram spinal fluid withdrawn; left table O. K.; no pain; felt sick at stomach when stomach was manipulated; spinal pressure 21. c.m.

In this case the anesthesia was all that could be desired, except that there was a little nausea when the stomach was handled. The pulse rate changed very little. The blood pressure dropped, but caused no inconvenience. The anesthetic lasted about two hours. With the previous narcotic, the patient's fears were allayed, and he responded very well, making a good recovery.

In fifty-two of these upper abdominal operations, the blood pressure fell, the greatest drop being 76 mm. and the least 2 mm., with an average fall of 28 mm. These changes were based on the record of the pressure before the operation began, and on that at the end before the patient left the operating room.

In three cases there was no change in pressure, and in six the blood pressure was higher at the end of the operation than before.

The use of spinal anesthesia in upper abdominal surgery is a distinct advantage over the inhalants. Anesthesia is more quickly induced. Within five minutes after the patient comes to the operating table the operation may be begun. No anesthetist is needed, the surgeon himself giving the spinal injection. A nurse or attendant should be on hand, however, to note pulse and respiration.

The abdominal walls are thoroughly relaxed, and sewing up is a very simple matter. There is very little shock because the spinal cord is temporarily blocked by the anesthetic, and no harmful impulses reach the brain. There is seldom any vomiting, except what might be expected after a gastro-enterostomy. No foreign substance is secreted in the stomach to produce emesis. No pneumonias follow this anesthetic, for the lungs are in no way affected. There have been no bad results following the spinal anesthesia as used here.